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## Predation on Alpine marmot, *Marmota marmota* (L.), by a golden eagle, *Aquila chrysaetos* (L.)

**Abstract** — A case of predation upon an Alpine marmot by a golden eagle is described.

**Riassunto** — Predazione di marmotta alpina, *Marmota marmota* (L.), da parte di un'aquila reale, *Aquila chrysaetos* (L.).

Viene descritto un caso di predazione di marmotta alpina da parte di un'aquila reale.

**Key words:** predation, Alpine marmot, golden eagle.

The Alpine marmot (*Marmota marmota* L.) inhabits meadow environments in mountain areas which provide good visibility of approaching terrestrial and aerial predators. Although tall vegetation may decrease the conspicuousness of active individuals (Hoogland, 1981; Armitage, 1982), Alpine marmots are never found within forested situations (Barash, 1976). This may indicate that they are probably more visually restricted than they are protected by tall vegetation, as recently suggested for yellow-bellied marmots by Carey & Moore (1986). The avoidance of tall vegetation may be an anti-predator tactics, as under these environmental conditions it seems possible for both a

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terrestrial predator, such as the red fox (*Vulpes vulpes*), and an aerial predator, such as the golden eagle (*Aquila chrysaetos*), to approach Alpine marmots without being detected. Unlike the yellow-bellied marmot (Waring, 1966), the Alpine marmot gives different types of alarm calls which are specifically associated with the potential predator. Thus, a single loud call is elicited by the golden eagle, whereas a series of short-interval calls is elicited by the red fox (Couturier, 1964: 145).

Predation on Alpine marmots has seldom been directly observed. There have been anecdotal descriptions of unsuccessful attacks on Alpine marmot by both red foxes and golden eagles (e.g. Couturier, 1964: 163); however, to my knowledge, no report account of predation by golden eagle has yet been described in the scientific literature.

During a study on the activity pattern of the Alpine marmot in Mount Cimone range, Tuscan-Emilian Apennine, central Italy (44° 11' N, 10° 42' E), I observed a case of predation upon an adult marmot by a golden eagle. Observations were made through a pair of binoculars 7 × 45 (Habicht, Austria) and a spotting scope with a variable 25-40 × 70 lens (Habicht, Austria) from a distance of approximately 500 m.

On 22 September 1988 at 1145 h (GMT) a golden eagle soared above the study area, which was on a steep north-facing slope interspersed with several rocky outcrops used by marmots as look out points. It was a sunny day and the golden eagle, approaching the slope from west (i.e. against the sun), was detected by a marmot that instantaneously gave a single loud call. As a result most marmots interrupted their feeding activity and disappeared safely underground. Shortly after the golden eagle abandoned the area. At 1600 h (GMT) the golden eagle came in at low angle from the south-facing slope of Mount Cimone, this time approaching the marmot foraging area from east. Taking advantage of a zone of relative shadow, the golden eagle reached the meadow, where two adult individuals of unknown sex were foraging, without being detected. In a matter of seconds the golden eagle grasped the back of a marmot, which gave a burst of long-interval calls. Then the eagle landed briefly on a large rocky outcrop a few meters above the site of capture and subsequently left the study area keeping the presumably dead marmot in its talons. In the meantime most marmots, including the individual foraging near that captured by the golden eagle, disappeared underground to resume their feeding activity approximately one hour later. Behaviour seemed normal on the following days and no marked shift in the use of foraging areas by marmots was observed.

Three aspects of this account are of interest. Firstly, the Alpine marmots of Mount Cimone, introduced there by man about thirty years ago (Ferri et al., 1988), proved capable of recognizing the shape of the golden eagle and of reacting efficiently to the alarm calls given by conspecifics. During the summer of 1988 I saw golden eagles soaring above Mount Cimone on nine additional occasions but the marmots consistently gave alarm calls, thus escaping the attack of the aerial predator. This finding is in agreement with similar indications derived from studies in the Alps (Pigozzi, unpublished data) and elsewhere (*Marmota caligata*, Noyes & Holmes, 1979). On the contrary kestrels (*Falco tinnunculus*) were often observed above the study area but they never seemed to alarm adult marmots. Secondly, the golden eagle came back twice during

the same day using two different techniques of attack. Since I noticed the absence of an outer primary feather from the right wing of the golden eagle involved in both attacks, it seems reasonable to rule out the possibility that two different individuals might be responsible for these predatory attempts. This account further indicates that a golden eagle may return to the same hunting ground despite being detected in a previous attempt only a few hours earlier. Finally, Alpine marmots did not alter the use of the foraging area where the predation had occurred. Interestingly, Armitage (1982) found that yellow-bellied marmots, suffering the loss of a member of the family due to predation by coyote (*Canis latrans*), required about a week before resuming the original use of the foraging area where the predation had occurred. Several factors may determine different behavioural responses by marmots following a case of predation. For example, the time of the year when predation takes place may be important as the activity (e.g. Bronson, 1962; Barash, 1973), as well as the quality and abundance of food resources exploited by marmots (e.g. Fall, 1971; Carey 1985a, 1985b; Martell & Milko, 1986) vary seasonally. The two yellow-bellied marmots were killed in July (Armitage, 1982), when the activity is generally high and food resources are rich (e.g. Carey, 1985b), whereas the Alpine marmot was killed by the end of September, when activity is somewhat reduced and food resources appear to be less available (Pigozzi, unpublished data). In addition, the anti-predator behaviour exhibited by marmots may be directly associated with the specific tactics employed by the predator (i.e. terrestrial or aerial approach) but also depend on several characteristics of the colonized environment (e.g. density of safety burrows, relative height of vegetation, spatial distribution of look out points) and on other attributes of the population (e.g. density of marmots, type of social structure, age-class composition).

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